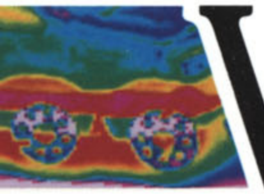
A New Content of Ideas



What happens if an astronaut on a space station of tomorrow needs an emergency appendectomy—and there is no surgeon on board?

Telesurgery is one possibility—surgery performed by a robot whose movements are precisely guided by a surgeon on Earth. He conducts the operation by a combination of computers, television and advanced sensors. The stereoscopic view entirely surrounds the doctor so that he feels he is actually a part of the space station scene, and he is able, through instrumented glove technology, to direct the robot's hand movements to correspond exactly to his own hand movements.

Way out? Not really, according to scientists at Ames Research Center's Aerospace Human Factors Research Division. Telesurgery is not now available, of course, but it is considered feasible for a 21st century time frame, say two to three decades from now. And it is only one of an infinite number of exciting potential applications for a burgeoning new technology called "virtual reality."

The technology is still at the "ground floor" level, still somewhat crude, requiring a great deal of development and refinement. But one of its basic components—3D computer graphics—is already in wide commercial use and expanding explosively. Other components that permit a human operator to "virtually" explore an artificial environment and to interact with it are being demonstrated routinely at Ames and elsewhere. Some of them, in fact, are already commercially available, albeit expensively, and the technology developed for one of Ames' artificial reality research tools—the instrumented glove—has even found its way into a video game.

Virtual reality (VR) might be defined as an environment capable of being virtually entered—telepresence, it is called—or interacted with by a human. One reason for NASA's interest is an anticipated need for large scale remote control of robotic space systems. Robots are becoming more and more sophisticated, more and more dextrous, and there is need for corollary development of devices, displays, skills and techniques that will allow telepresence and effective telerobotic control.

Since the mid-1980s, Ames' Aerospace Human Factors Research Division has been developing experimental systems that permit human/computer interaction. For example, the VIEW system. VIEW stands for Virtual Interface Environment Workstation. It is a head-mounted stereoscopic display system in which the display may

Photo by Wade Sisler

Above, a NASA scientist is conducting a test of Ames Research Center's "virtual reality" headset. She sees a computer-generated 3D scene or a real environment remotely relayed by video cameras; the stereo imagery suggests that she is actually part of the scene.

Topping a selection of spinoffs in computer technology are hardware/software systems for advancing the exciting concept of virtual reality

be an artificial computer-generated environment or a real environment relayed from remote video cameras. The operator can—virtually at least—"step into" this environment and interact with it.

He wears a headset whose centerpiece is a display box containing two small (3.9-inch) television screens, one for each eye so that the TV image appears three dimensional. The scene is accompanied by appropriate sound effects delivered to the headset. The headset bars view of anything but the imagery, thus helps create the illusion that the user is part of the scene pictured. One example of an important practical application: a design engineer can virtually become part of the fuel flow of a rocket engine and travel with the flow, noting places where it slows, speeds up or becomes turbulent; he can learn a great deal about system design that he could not in 2D simulation.

The scene might be a room. If the operator turns his head, the scene shifts just as it would in the real world; a headset-mounted sensor tracks the position of the user's head and communicates this knowledge to the computer. By pointing in a given direction, the operator virtually moves in that direction so he can explore any part of the room. Ames is developing a library of software for various scenes and the operator can select a menu option by a word or gesture, because the system is trained to recognize voice and gesture commands.

An important addition to the Ames system is the DataGlove™, an experiment in telepresence control of advanced robotic hands or fingers. Developed for Ames by VPL Research, Inc., Redwood City, California, the glove has a series of fiber optic cables and sensors that detect any movement of the wearer's fingers and transmit the information to a host computer; a computer-generated image of the hand will move exactly as the operator is moving his gloved hand. With appropriate software, the operator can use the glove to interact with the computer scene by grasping an object, for example, moving a virtual chair within the simulated room; the computer will dutifully move the chair in the TV display. Not only that, the operator can "feel" the virtual chair through tiny vibrators in the fingertips of the DataGlove.

It is possible, Ames and other VR researchers feel, to replicate almost any environment or activity, so VR has immense potential, both as a research tool and an operational system for telepresence/telerobotics.

The possibilities for practical applications of VR in everyday life are even broader, thinks Jaron Z. Lanier. Lanier is chief executive officer of VPL Research, developer of the DataGlove and other systems for creating virtual reality, which he describes as "a new continent of ideas."

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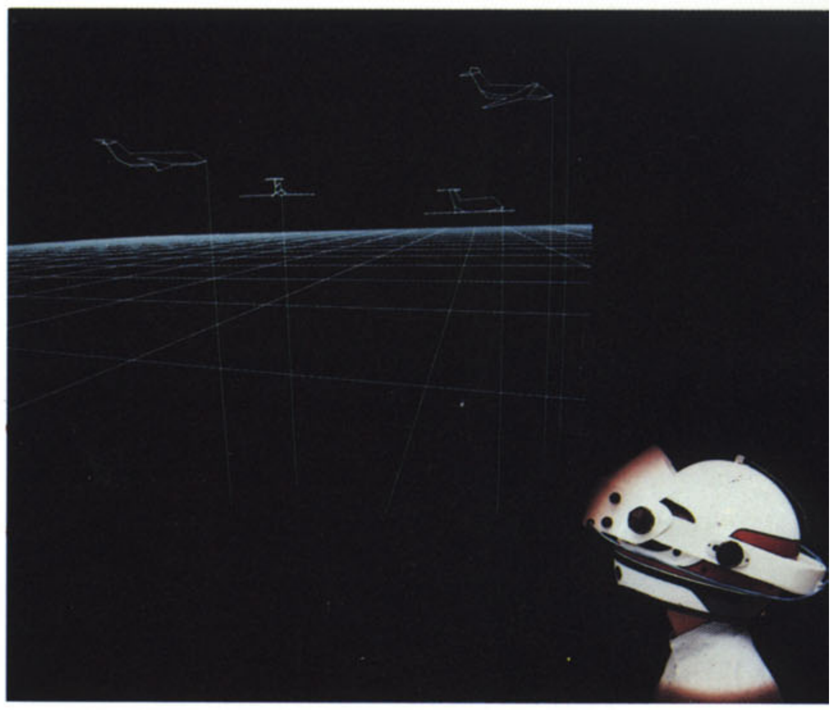

A possible future application of virtual reality: an air traffic controller wearing a helmeted version of the headset monitors aircraft from a virtual viewpoint in the airspace.

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